THESIS

A STUDY OF THE REPRODUCTIVE SYSTEM OF THE FEMALE DOMESTIC FOWL

RAYMOND HARVEY WILKINS

1915

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A STUDY OF THE

REPRODUCTIVE SYSTEM

OF THE FEMALE DOMESTIC FOWL

BY

RAYMOND HARVEY WILKINS

1915.

THE DEVELOPMENT OF THE REPRODUCTIVE SYSTEM OF THE FEMALE DOMESTIC FOWL.

The idea set forth in this work is to show the development of the female reproductive system of the domestic fowl from the time the bird is first hatched until it has reached full maturity. With this idea in view eleven different periods in the life cycle of the fowl have been chosen. The birds used in this study were S. C. White Leghorns. The following ~~is~~ are the different periods selected as a basis of this study :

Group 0 - The day old chick

Group 1 - The pullet when three months old.

Group 2 - The pullet when four months old.

Group 3 - The pullet when five months old.

Group 4 - The pullet when approaching the period of first production, as shown by its great comb development.

Group 6 - The pullet after having laid but a single egg

Group 5 - The pullet after having laid for a period of two or three weeks.

Group 7 - The pullet when about 18 months old and just prior to the close of its first laying season.

Group 8 - The bird when in the state of broodiness.

Group 9 - The bird after having ceased to lay when about 18 months old.

Group 10- The bird when in a state of molting.

Group 11- The hen after molting, vigor being regained and having again started to lay.

Plan of Procedure :

Three birds from each of the above groups were selected and all received the same treatment. The plan followed was to photograph the live birds. After this the bird was killed by

training. However, the bird was not bled as it was desired to maintain the organs of the body in as natural a condition as possible. The ventral portion of the body was removed by cutting with a pair of shears from the cloaca around both sides of the body wall, then through the breast. This portion is removed, and with it all of the internal organs in the abdominal cavity with the exception of the ovary and oviduct. These were not molested but allowed to remain in their natural position in the body cavity. They were then photographed. After this they were removed from the body and all mesentery tissue was removed, after which they were weighed and the length of the oviduct was recorded. Without stretching the oviduct these organs were fastened on to a cross section board and photographed. After this the specimens were mounted on to a black glass background, and placed in museum jars containing a 10% solution of formalin.

The following characteristics of each of the birds studied was as follows :

External appearance :

Condition

Vigor

Weight

Condition of comb

Condition of plumage

Internal appearance :

Condition of fat

Condition of ovary and oviduct, as to whether it was functioning or dormant.

Weight of the ovary

Weight of the oviduct

Length of the oviduct.

The organs of reproduction of the domestic fowl are the ovary and the oviduct. During the early embryonic life of the chick, there is a presence of two ovaries and oviducts, one on each side of the spinal column. However, in the case of the right Mullerian duct or oviduct and ovary, degeneration starts during the eighth day and by the fifteenth day there is only a slight trace of the organs left. Unless of a freakish nature, the right Mullerian duct never matures, and thus never obtains an opening into the cloaca. As a result the functional ovary and oviduct are always located on the left dorsal side of the abdominal cavity of the fowl. The cause of this degeneration is not definitely known but would appear to be correlated with the large size of the egg as there is not room in the region of the cloaca for the two eggs to lie side by side.

The ovary lies at the anterior end of the kidney and is attached to the dorsal wall by means of a fold of peritoneum called mesovarium.

The oviduct of the hen is suspended from the dorsal body wall and lies just back of the abdominal air sac. By means of both dorsal and ventral ligaments, the oviduct is held in place in such a manner that the infundibulum lies directly beneath the ovary and is able to receive the ripened ovum at time of ovulation.

By means of the air sac and different layers of mesentery tissues a protective wall is formed around the ovary. Of this Curtis in Maine Bulletin No. 176, says "There is formed in the hen a sort of 'pocket'. The pocket is of such a nature that quite apart of any physiological activity on the part of the funnel of the oviduct the ova separated from the ovary at ovulation are mechanically directed toward the

funnel mouth.

As before stated the ovary in its entirity is present in the hen during the embryonic development. During the early development it is simply a muscled mass containing humerous minute ova, and as the bird approaches her period of production some of the inert ova start development. As an anatomical basis of study for fecundity, the Maine Station made a study of the visible oocysts in the ovary of certain birds. Of the fifteen birds examined for Maine Bulletin No. 205, it was found that the range of visible oocysts came between the limits of 914 and 3605. The conclusion drawn from this study leads one to believe that some other factor besides an anatomical one is paramont as regards fecundity in the domestic fowl. Handrik has recorded a Leghorn hen as having laid 969 eggs in seven years. With such a large number of ova present, the necessity of breeding for longevity is evident.

The following account of the structure of the oviduct is taken directly from Maine Bulletin No. 206 : "The ov~~ary~~iduct of the hen consists of five more or less clearly delimited regions, beginning at the anterior end of the oviduct, these are ordinarily designated as (1) The funnel; (2) the albumen secreting portion; (3) the isthmus; (4) the uterus or shell gland and (5) the vagina. The funnel, known in anatomical terms as the ostinum tubae abdominale, is a delicate, thin-walled portion lying immediately ventrical~~y~~ to the ovary. Its anterior end is expanded into ~~a~~ long lip-like processes. The lips quickly converge to form a rather narrow thin-walled tube. In the functional oviduct the length of this tubular portion(funnel neck) is from 2 to 4 cms. The epithelium of the wall of the funnel is folded in rather long, longitudinal, spiral ridges,

These ridges with more or less interruptions are continuous throughout the oviduct. They are greatly increased in height in the lower portions of the duct. Besides these primary ridges the epithelium also forms smaller secondary folds. These secondary folds are best developed in the posterior portion of the funnel. Their presence in other portions of the oviduct is somewhat obscured by the enormous development of the glands. As will be pointed furhter on these secondary folds bear important relations to the large glands.

The funnel region grades rather gradually into the albumen secreting portion. There is no difficulty in distinguishing between these two regions. In the albumen portion the walls are much thicker and the longtidunal ridges are very much higher. This albumen portion is the longest of the five divisions. The average length is about 42 cms. in the functional oviduct. The division between the albumen portion and the isthmus is very sharply marked. The real limit of the true regions appears as a narrow line extending around the oviduct. However, for some distance on either side of this the character of the longitudinal ridges is quite different.

In general appearance the isthmus resembles the albumen portion except that the ridges are not quite so high and the walls are more contracted forming a narrower portion of the duct. The isthmus in the laying hen measures on the average about 12 cms. in length. The distinctive function of the isthmus is to secrete the shell membrane.

The isthmus is continued without any clear line of demarkation into the expanded portion known as the uterus or shell gland. The character of the ridges is quite different in the uterus. They are more numerous and are greatly broken

up by transverse and diagonal folding. The walls of the uterus are not so thick as those of the last two mentioned regions. The length of this organ is also about 12 cms. The lower end is rounded by the large sphincter muscle.

The vagina extends from this sphincter to the cloacal wall. The walls of the vagina are very muscular. The epithelial walls are much smaller than in the preceding section. The length of the vagina is between 12 and 15 cms.

The length of time for the ovary to develop is not definitely known. Environmental conditions, feeding, etc., no doubt, influence its development from a minute ova up to the size of a pea. From this period on, the data at hand shows that on an average it takes 10 to 14 days to ripen and enter into the oviduct. Riddle has stated that this period of development may occur in eight days.

The ova during development is encased in a membrane tissue called the follicle. This follicle contains small blood vessels which nourish the ova during its development. When ripe the follicle splits along the suture line and the ova falls into the funnel of the oviduct. The follicle is then almost entirely reabsorbed and taken into the body. Dr. Pearl states that under microscopic examination, the scar formed from the absorption of the follicle may be ascertained.

In the normal egg in the hen there are three distinct layers of albumen secreted by the oviduct. These are as follows: the chalaziferous layer, which is very dense and lies just outside the true yolk membrane; 2nd, the dense albumen which is next to the chalaziferous layer and composes the bulk of the white of the egg. It is this layer that gives shape to the egg when broken and poured into a saucer; 3rd, the fluid

albumen which makes up the fluid part of the white of the egg."

The prevailing opinion has been that the white of the egg is entirely secreted by the albumen secreted portion of the oviduct. Pearl and Curtis have made a rather extended study of this question and a summary of their finding taken from Exp. Zoology Vol. 12, 1912, follows :

1. After entering the infundibulum the yolk remains in the so-called albumen portion of the oviduct about three hours, and in this time acquires only about 40 to 50 per cent by weight of its total albumen and not all of it, as has hitherto been supposed.

2. During it's sojourn in the infundibular and albumen portions of the duct the egg acquires its chalazae and chalaziferous and the thick albumen layer.

3. Upon entering the isthmus, in passing through which portion of the duct sometimes under an hour's time is occupied instead of three hours as has been previously maintained, The egg received its shell membrane by a process of discreet deposition.

4. At the same time and during the sojourn of the egg in the uterus it receives its outer layer or thin albumen, which is by weight 50 to 60 per cent of the total albumen.

5. This thin albumen is taken in as a dilute fluid by osmosis through the shell membranes already formed. The // fluid albumen added in this way diffuses into the dense albumen already present, dissolves some of the latter and so brings about its dilution in some degrees. At the same time the fluid albumen is made more dense in the process of diffusion and comes to have the consistency of the thin albumen layer of the normal laid egg. The fluid albumen taken into the egg by osmosis is a definite secretion of glands of the isthmus and

uterus. The addition of albumen to the egg is completed only after it has been in the uterus from five to seven hours.

7. Before the acquisition of the albumen by the egg is completed a fairly considerable amount of shell substance has been deposited on the shell membrane.

8. For the completion of the shell and the laying of the egg from 12 to 16 or even more hours are required.

Owing to the structure of the reproductive system of the hen it is impossible to determine the exact place at which fertilization occurs. The life period of the germ cells is quite remarkable, and fertilization has been known to occur 26 days after the removal of the male. Since the albumen surrounds the egg in the upper part of the oviduct or immediately after leaving the infundibulum, it is thought that the male and female cells unite in the uppermost part of the oviduct. Of this L. F. Payne of Oklahoma Agricultural and Mechanical College in Canadian Poultry News says, "We are almost forced to drop the theory that ova are not fertilized until they leave the follicle of the ovaries and enter the oviduct, for as soon as the male and female cells unite fertilization is complete and development starts. The growth continues to such an extent that a newly laid egg when broken can in many cases be identified as fertile or infertile, by observing the size of the blastoderm or germ. This development being apparently the same in all fresh eggs, leads us to believe that this union occurs at about the same place for each egg since it requires from 18 to 20 hours for it to pass down the oviduct. If the sperm cells pass beyond the oviduct and fertilize the ova before they were developed and ready to pass from the ovaries growth would begin at once, and the germs would

vary in size according to the period of time they remain in the body cavity. For example, if fertilization should occur as much as 10 days before the egg is laid, we might expect a half developed chick when the egg passed from the uterus, but as this is not the case cells must remain active in the region of the infundibulum until the ovum passes from its follicle and is swallowed up by the oviduct where uniting of the two cells takes place.

The development of the reproductive system as studied from the eleven different periods of the fowl's life are shown in the different photographs on pages .

From the photographs pages , it is seen that the ovary and oviduct are simply a small muscled mass and a straight tube slightly increasing in size with the growth of the bird. The birds are also in a poor condition of fat and show no great comb development.

Group 4 shows the reproductive system from these birds five months and two weeks old. These birds show great comb development and have assumed a more matured appearance. The three birds here studied show three distinctive stages in the development of the reproductive system.

Bird A, shows great development as to the size of the ovary and the length of the oviduct; while not having laid it is apparent that she would have been functioning within a few days as evidenced by the size of some of the ova.

Bird B. shows the reproductive organs in a lesser stage of development. However, the ovary has started to grow and production would have begun in a short time.

Bird C, while possessing the same external characters as the other two birds of this group shows no development what-

soever.

All of the birds of this group were very fat. Doubtless bird C would have started to function in a few weeks, since she did possess all of the other characteristics in common with Birds A and B.

Group 6* shows fowls that have laid but a single egg. These birds were placed in individual exhibition coops and carefully observed. As soon as the first egg was laid the bird was killed and photographed. There appears to be no difference in the condition of the oviduct through which a single egg has passed and one through which a number of eggs has passed. Bird A of this group possessed an oviduct of the greatest length of any observed in this study (29 inches). However, the oviducts of birds B and C were only $24\frac{1}{2}$ and $26\frac{1}{2}$ inches long and this seems to be close to the average length of the oviduct when in the state of reproduction.

Group 5 or Birds 6 months of age which have laid several eggs and Group 7 composed of birds 16 to 18 months of age and about to close their first laying season, show the same development as Group 6, which has laid but a single egg.

Group 8 or the fowl in the state of broodiness contains but one bird; owing to the lateness of the season in starting this work, it was impossible to obtain but one individual of this group.

Here it is seen that the bird while in a good condition of fat and health has ceased to function. The ovary has been reduced to a muscled mass and the oviduct has shrunken to less than half the size of an oviduct from a fowl in state of production.

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* In order of development Group 6 should be placed before Group 5

The birds of Group 9 are those about 18 months of age and having ceased to lay at the end of their first laying season. The same condition appears here as in a hen in the state of broodiness. The ovary has been reduced to a small muscled mass and the oviduct has decreased to about 12 inches in length. Group 10 or the birds in the state of molt show the fowl at the lowest point of vitality in its normal life. The reproductive system seems to act with the rest of the body as it is smaller in size at this time than any other time during the mature life of the fowl. At this stage the ovary is very small and weighs only about 3 to 4 grams. In this respect it is closely related to Group 3 or birds 5½ months old, and not having started to show any great comb development. The oviduct has also reduced in size to a greater extent than any of the other groups and is ohly 6 to 8 inches in length.

These birds were in a good condition ~~in~~ of fat, but this is caused, no doubt, by the fact that the birds were killed before they had been molting long enough to be reduced to their lowest condition.

Group 11 shows the birds after having gone through the molt, and again started to lay. They have taken on new plumage and have fortified themselves with an excess of fat, In preparing themselves for the laying season. As can be seen from photographs on pages the ovary and oviduct from these birds is in the same stage of development as regards size, as birds of Groups 5, 6 and 7.

The curve on page shows the development of the oviduct from the time the chick was first hatched until it has resumed its second season's laying. By studying this table and the records of each group, pages as regards external characters

such as condition of comb, plumage, etc. It has been found that the development of the reproductive system is at its highest when these external characters appear best

The development of the ovary follows the same general rule and doubtless the functioning of this organ is correlated to a considerable extent to the amount of fat containe in a fowl's body. It is a well established fact that an animal in a pregnant condition takes on surplus fat. The hen when in a functioning condition is simply attempting to reproduce herself. It is for this reason, no doubt, that the hen takes on more fat just prior to egg production and during egg production than when in a dormant condition.

Group 0 - The day old chick.

External appearance :

BIRD A

Condition - Fair

Weight - 1.7 oz.

Vigor - Fair

Condition of comb - Not developed

Condition of plumage - Downy

Internal appearance :

Condition of fat - slight

Condition of ovary and oviduct - Dormant

Weight of ovary - .03 grams

Length of ovary - 1¾"

Group 1 - The pullet when three months old.

External appearance :

	Bird A	Bird B	Bird C
Condition -	Good	Good	Good
Vigor -	Good	Good	Good
Weight -	1-1/16 lbs.	1 lb.	15/16 lb.
Comb -	Just starting to develop.		

Internal appearance :

Condition of fat	Poor	Poor	Poor
Reproductive system	Dormant	Dormant	Dormant
Weight of ovary	.35	.32	.27
Weight of oviduct	.18	.21	.16
Length of oviduct	2½"	2¾"	2-5/8"

Group 2 - The pullet when four months old.

External appearance :

	Bird A	Bird B	Bird C
Condition -	Good	Good	Good
Vigor	"	"	"
Weight	1 lb. 9 oz.	1 lb. 10oz.	1 lb. 7 oz
Condition of Comb	Just starting to develop		

Internal appearance :

Condition of fat	Fair	Poor	Poor
Reproductive system	Dormant	Dormant	Dormant
Weight of ovary	2.3 gr.	2.5 gr.	3.2 gr.
Weight of oviduct	1.2 gr.	1.2 gr.	.9 gr.
Length of oviduct	4"	3.7/8"	3¼"

Group 3 - The pullet when five months and 2 weeks old.

External appearance :

	Bird A	Bird B	Bird C
Condition	Good	Good	Good
Vigor	"	"	"
Weight	1 lb. 8 oz.	2 lbs.	2 lbs. 3 oz
Condition of comb	A little farther developed than Group 2.		

Internal appearance :

Condition of fat	Poor	Poor	Poor
Reproductive system	Dormant	Dormant	Dormant
Weight of ovary	2½ gr.	2.1 gr.	3.7 gr.
Weight of oviduct	3.2	3.4	3.5
Length of Oviduct	3½"	4"	4⅜"

Group 4 - The pullet when approaching the period of first production, as shown by its great comb development. In this case, 5 mo. and two wks. old.

External appearance :

	Bird A	Bird B	Bird C
Condition	V. Good	V. Good	V. Good
Vigor	" "	" "	" "
Weight	3 lbs.5oz.	3lbs.3oz.	2lbs.9oz.
Condition of comb	Just starting to lop over but not fully developed.		

Internal appearance :

Condition of fat	Heavy	Heavy	Heavy
Condition of ovary and oviduct	Not entirely developed	Starting to develop	Dormant
Weight of ovary	6.55 gr.	1.7 gr.	.72 gr.
Weight of oviduct	22 gr.	10 gr	1½ gr.
Length of oviduct	18.1/8"	12¾"	7-7/8"

Group 6 - The pullet after having laid **but** a single egg.

External appearance :

	Bird A	Bird B	Bird C
Condition	Good	Good	Good
Vigor	V.Good	V.Good	V.Good
Weight	3lbs.14oz.	4lbs.2oz.	4lbs.1oz.
Condition of comb	Fully developed for all birds.		

Internal appearance :

Condition of fat	Heavy	Heavy	Heavy
Condition of ovary and oviduct	Full state of functioning		
Weight of ovary	35½ gr.	40 gr	38½ gr.
Weight of oviduct	82 gr.	74 gr.	75½ gr.
Length of oviduct	29"	24"½	26½"

Group 5 - The pullet after having laid for a period of two or three weeks. 5 mo. and 3 weeks old.

External appearance :

	Bird A	Bird B	Bird C
Condition	V.Good	V.Good	V.Good
Vigor	" "	" "	" "
Weight	3lbs.4oz.	5lbs.9oz.	3lbs.9oz.
Condition of comb	Fully developed for all birds		

Internal appearance :

Condition of fat	V. Heavy	V.Heavy	V.Heavy
Reproductive system	Full state of functioning.		
Weight of ovary	35½ gr.	31 gr.	33½ gr.
Weight of oviduct	30 gr.	26 gr.	34 gr.
Length of oviduct	23½in..	25"	24½"

Group 7 - The pullet when about 18 months old and just prior to the close of its first laying season.

External appearance :

	Bird A	Bird B	Bird C
Condition	V.Good	V.Good	Good
Vigor	V.Good	" "	"
Weight	3lbs.12oz.	3lbs.2oz.	3lbs.15oz.
Condition of comb	Fully developed for all birds		

Internal appearance :

Condition of fat	Heavy	Fair	Fair
Reproductive system	Full state of functioning		
Weight of ovary	29.3 gr.	37.2 gr.	38.4 gr.
Weight of oviduct	64.8 "	81.5 "	77 "
Length of oviduct	25"	26-1/8"	25½"

Group 8 - Bird in state of broodiness.

External appearance :

	Bird A
Condition	Good
Vigor	Fair
Weight	2.7 lbs.
Condition of comb	Slightly shrunken.

Internal appearance :

Condition of fat	Good
Reproductive system-	Dormant
Weight of ovary	2.9 gr.
Weight of oviduct	5.7 gr.
Length of oviduct	11¾"

Group 9 - The bird after having ceased to lay when about 18 months old.

External appearance :

	Bird A	Bird B	Bird C
Condition	Good	Good	V.Good
Vigor	"	"	" "
Weight	4lbs.1oz.	2lbs.13oz.	2lbs.12oz.
Condition of comb	Fully developed	slightly shrunken	Fully developed

Internal appearance :

Condition of fat	Heavy	Medium	Medium
Reproductive system	Dormant	Dormant	Dormant
Weight of ovary	3.6 gr.	3½ gr.	4.2 gr.
Weight of oviduct	4.4 gr.	6.3 gr.	5.6 gr.
Length of oviduct	12¼"	12"	10¾"

Group 10 - The bird when in state of molting.

External appearance :

	Bird A	Bird B	Bird C
Condition	Poor	Poor	Poor
Vigor	"	"	"
Weight	3lbs.12oz.	2lbs.9oz.	2lbs.7oz.
Condition of comb	Shrunken - very rough in texture		

Internal appearance :

Condition of fat	Medium	Heavy	Medium
Reproductive system	Dormant	Dormant	Dormant
Weight of ovary	4½ gr.	1.75 gr.	3.1 gr.
Weight of oviduct	5.2 gr.	2.6 gr.	4.6 gr.
Length of ofiduct	4-11/16"	7½"	7¾"

Group 11 - The hen after molting, vigor being regained and having again started to lay.

External appearance :

	Bird A	Bird B	Bird C
Condition	Good	Good	Good
Vigor	V. "	V. "	V. "
Weight	4lbs.1oz.	3lbs.2oz.	3lbs.7oz.
Condition of comb	Fully developed - fine texture.		

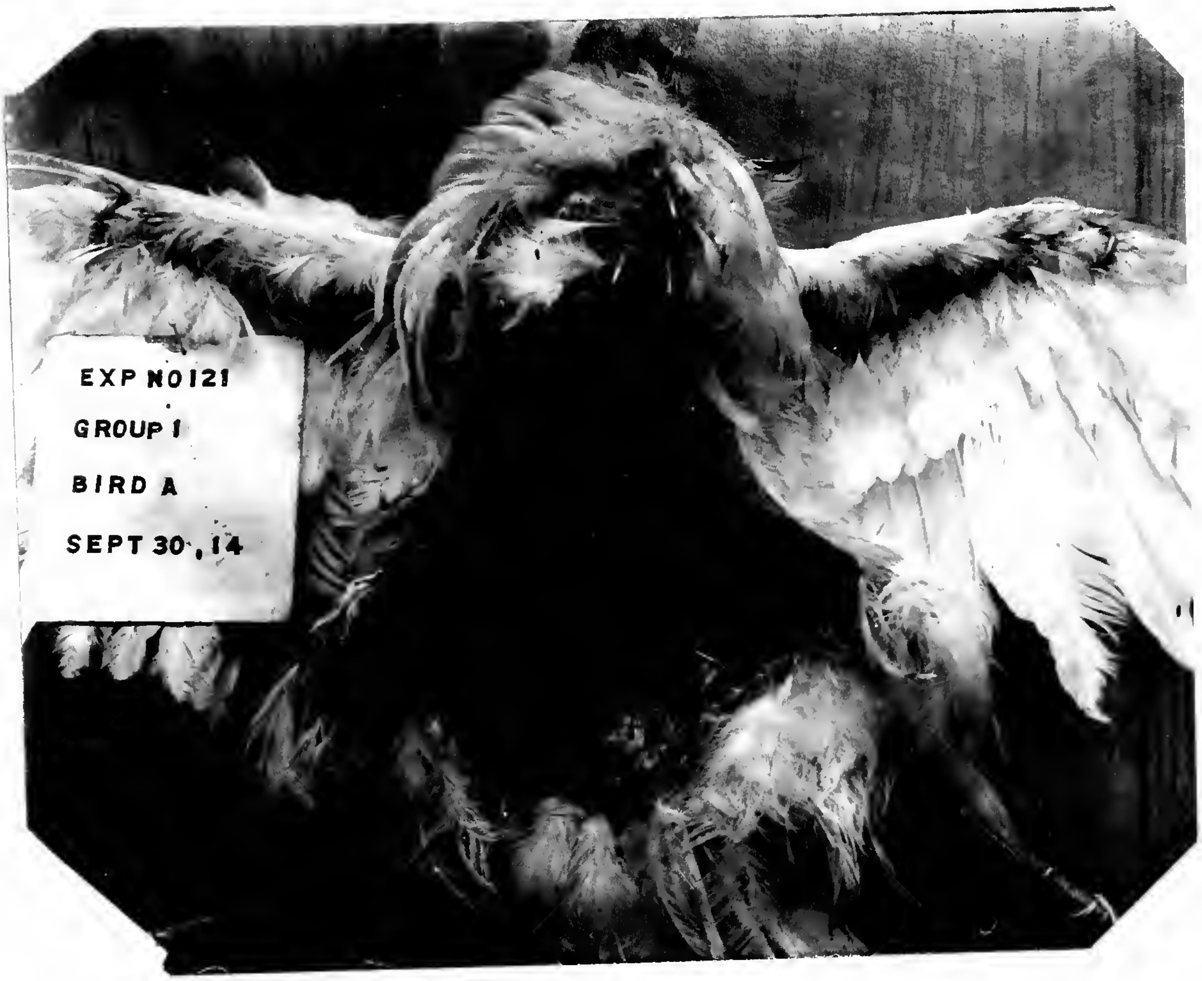
Internal appearance :

Condition of fat	Heavy	Heavy	Heavy
Reproductive system	Full state of reproduction		
Weight of ovary	43 gr	58 gr.	45 gr.
Weight of oviduct	62. gr.	91½ gr.	73 gr.
Length of oviduct	25-3/8 "	26½"	28¼"

Reproductive system of the female domestic chick

one day old.

Reproductive System of pullet hen 3 months old.

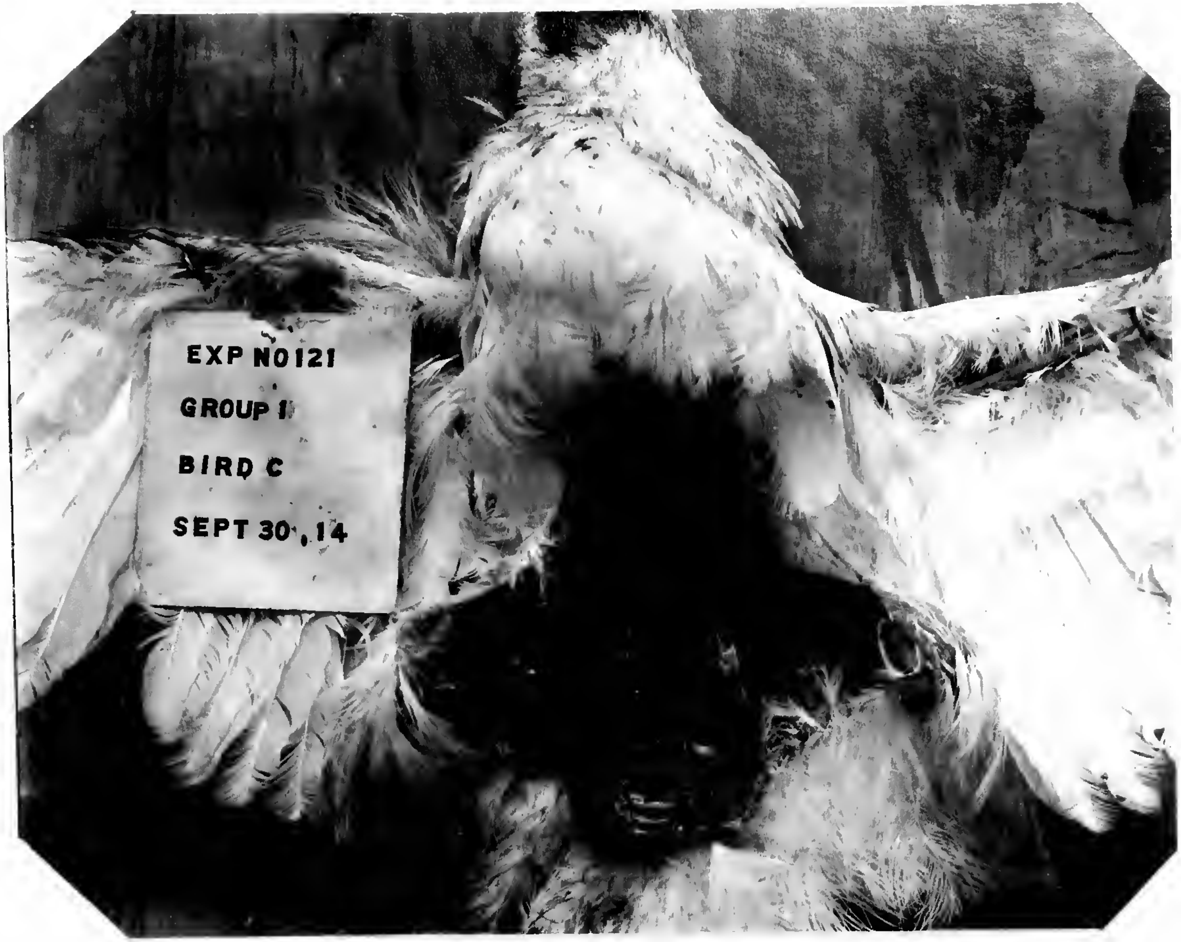


Group 1-Bird A.

Reproductive system of pullet hen 3 months old, lying in natural position in the body cavity.

Group I-Bird B.

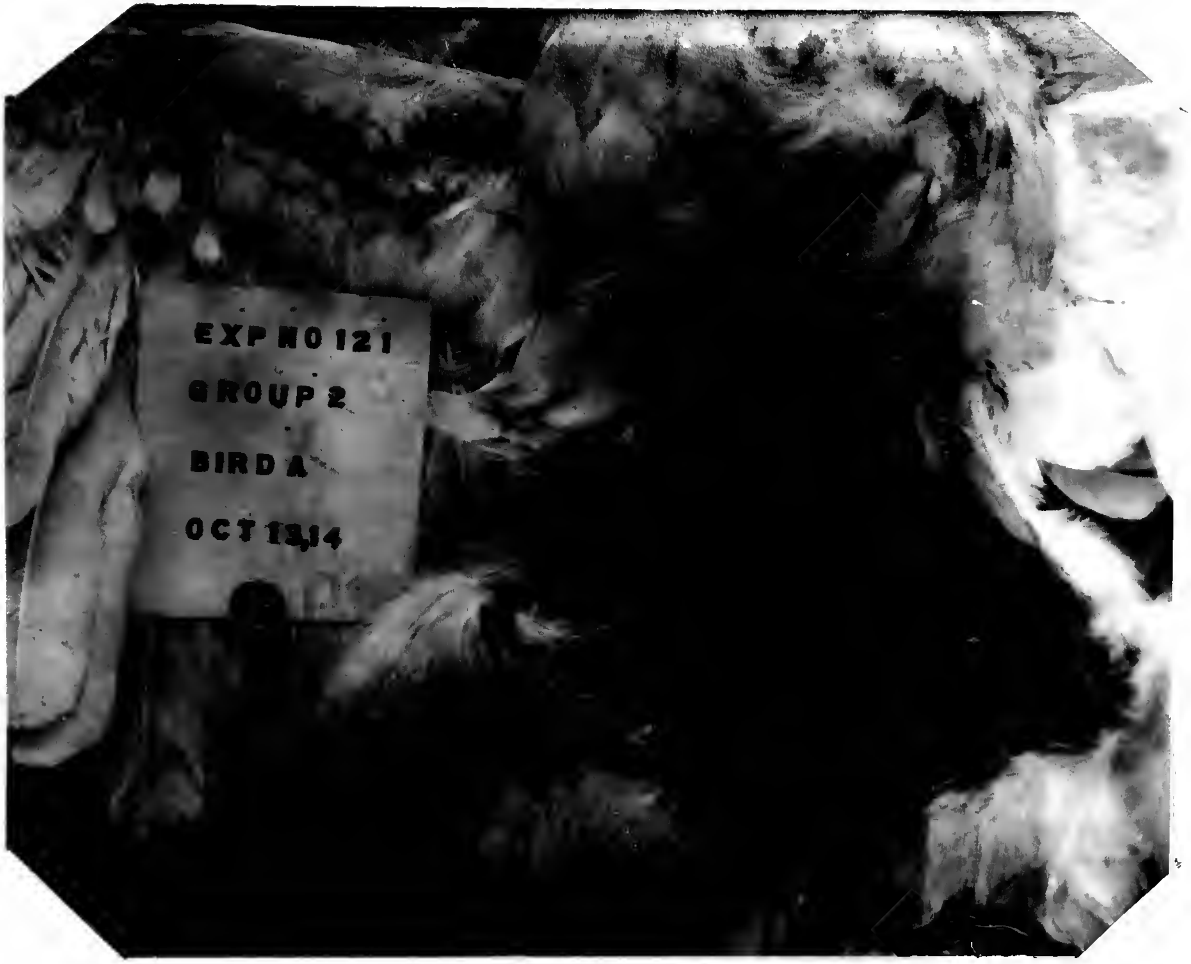
Reproductive system of pullet hen 3 months old, lying in natural position in the body cavity.



Group I-Bird C.

Reproductive system of pullet hen 3 months old, lying in natural position in the body cavity.

Reproductive system of pullet hen,4 months old.



Group 2-Bird A.

Reproductive system of pullet hen 4 months, lying in natural position in the body cavity.

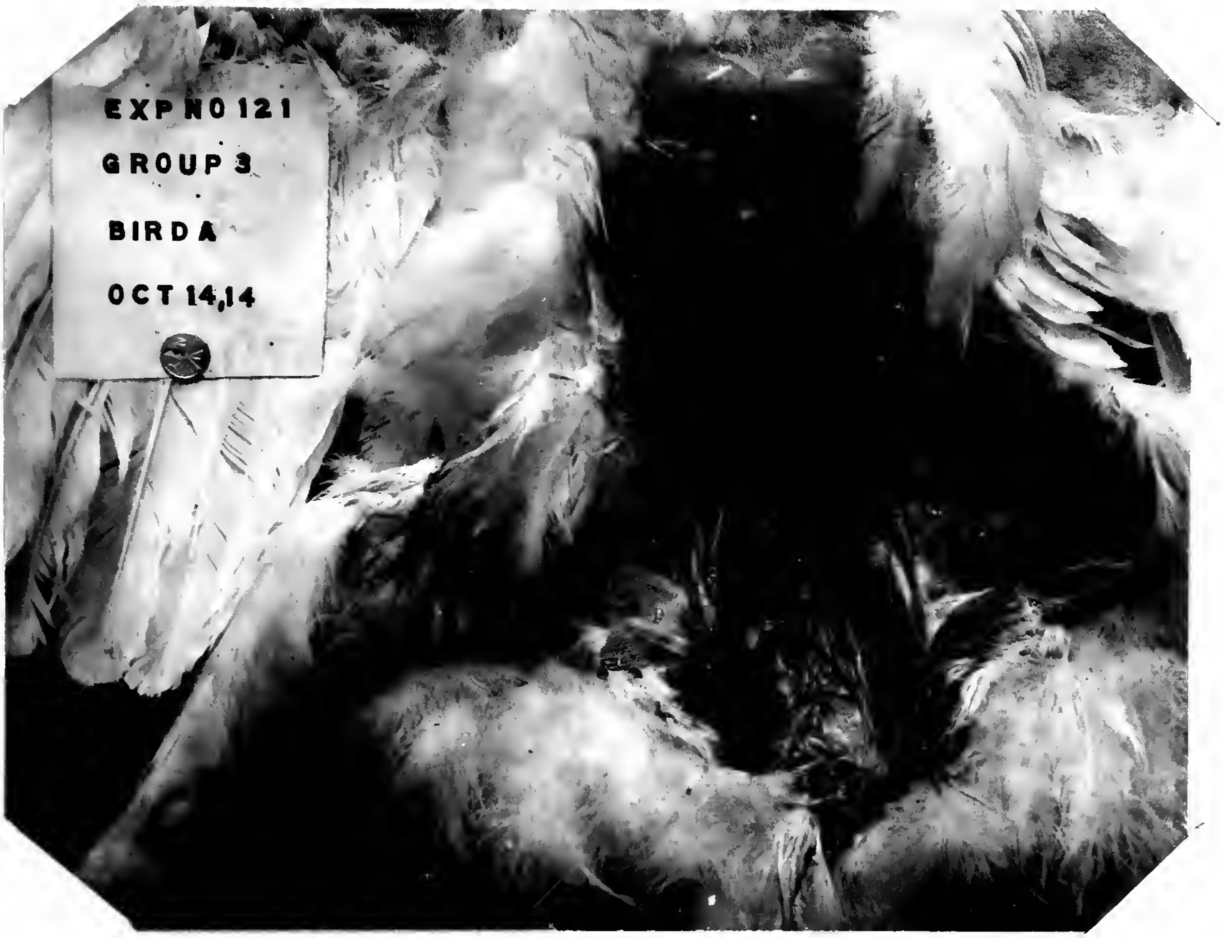
Group 2-Bird B.

Reproductive system of pullet hen 4 months old, lying in natural position in the body cavity.

Group 2-Bird C.

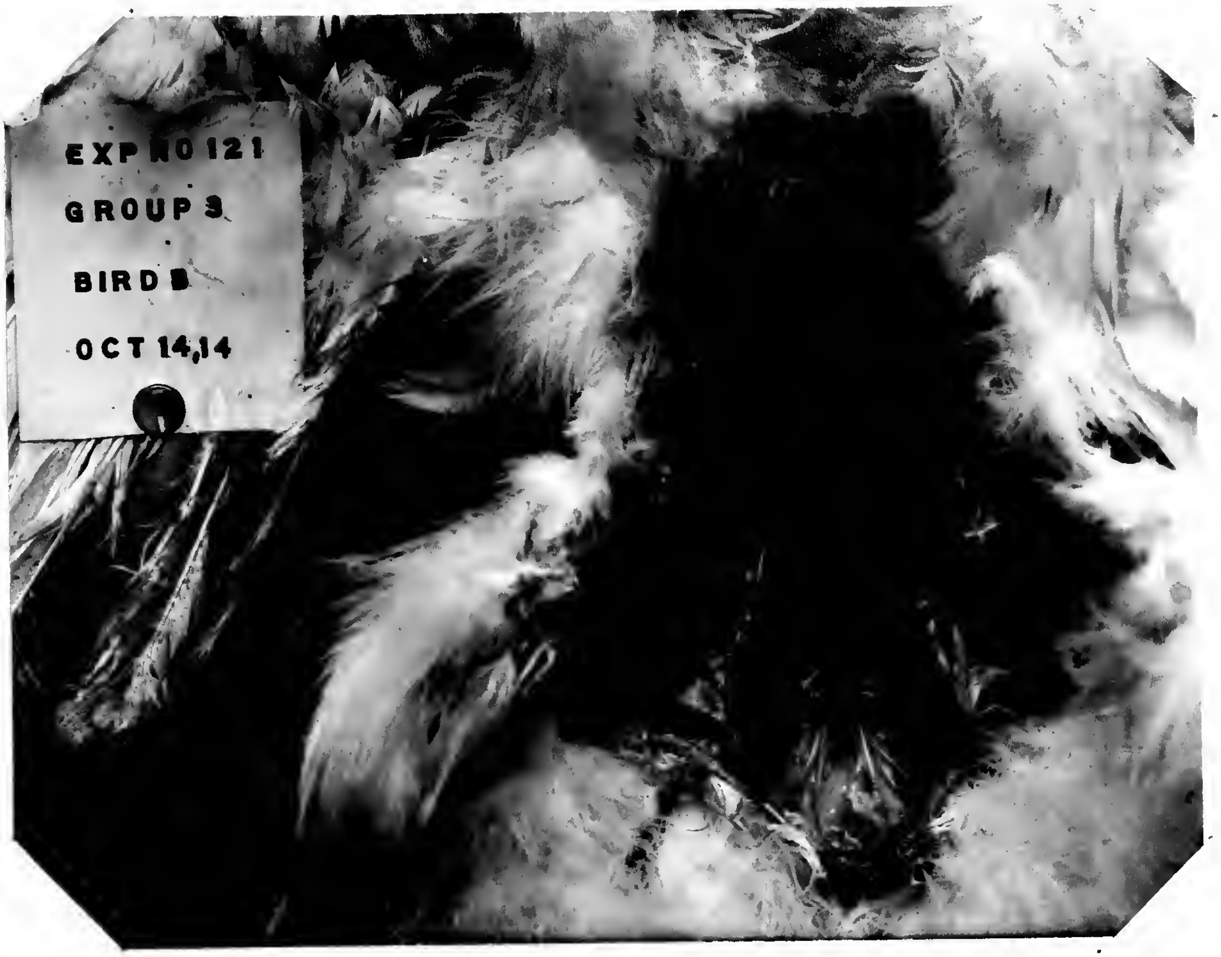
Reproductive system of pullet hen, 4 months old, lying in natural position in the body cavity.

Reproductive system of pullet hen, 5 months and two weeks old and not showing any pronounced appearance of mature development.



Group 3 Bird A.

Reproductive system of pullet hen. 5 mos. and 2 wks. old lying in natural position in the body cavity. This bird showed no signs of mature development.



Group 3-Bird B.

Reproductive system of pullet hen 5 mos. and 2 wks old lying in natural position in body cavity.Bird showed no signs of mature development.

Group 3 Bird C.

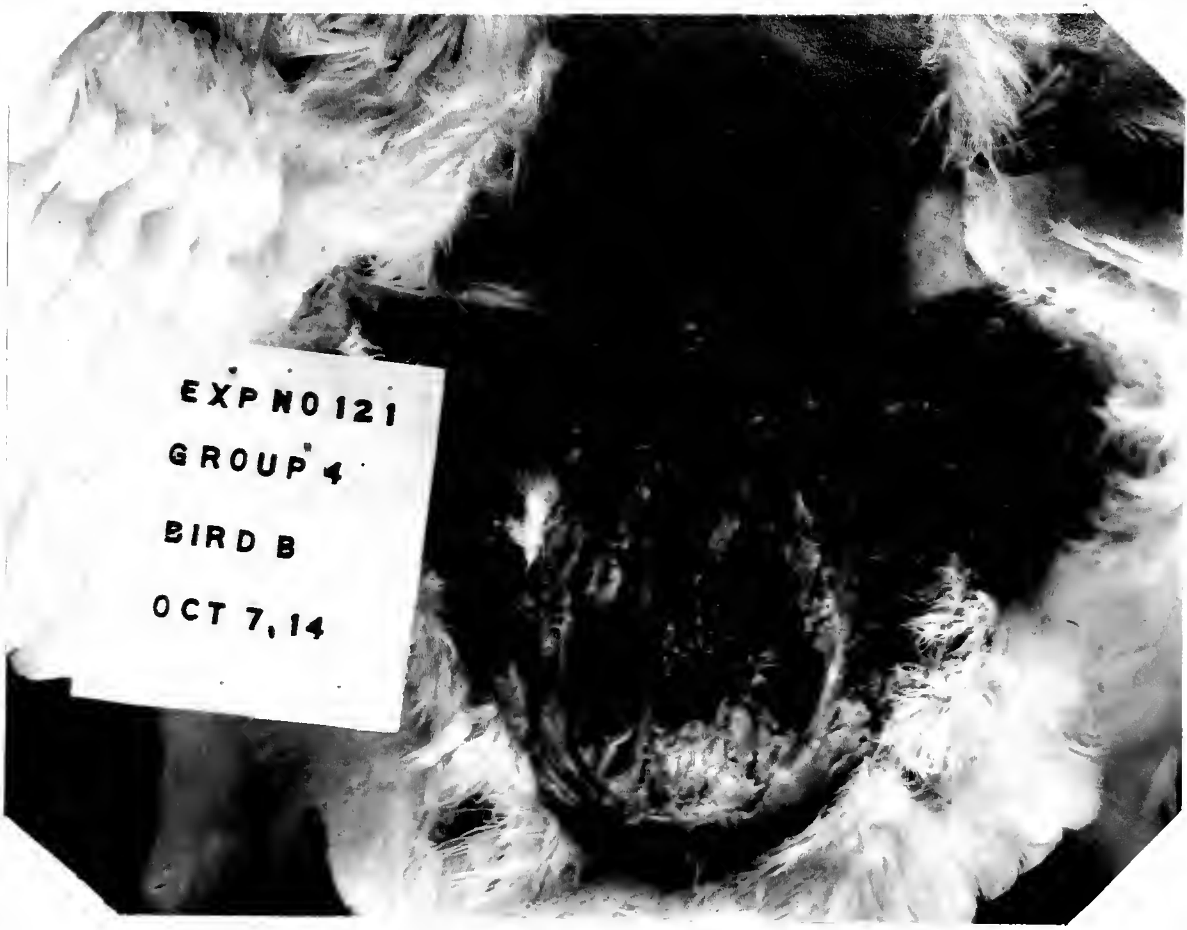
Reproductive system of pullet hen 5 mos. and 2 wks old lying in natural position in the body cavity. This bird showed no signs of mature development.

Reproductive system of pullet hen, 5 mos and 2 weeks old, and showing evidence of approaching the period of production, by showing great comb development, and other external characteristics.

.Note the three distinct stages of development of the ovary and oviduct, from birds of the same age.

Group 4-Bird A

Reproductive system of pullet hen, 5 mos and 2 wks. old lying in natural position in the body cavity. This bird showed great comb development and other external characteristics, signifying the approachf of theperiod of production.



Group IV Bird B.

Reproductive system of the pullet hen 5 mos and 2 wks. old in natural position in the body cavity. This bird showed great comb development and other external characteristics signifying the approach of the period of production.

Note the lesser degree of development as compared with the predeeding bird, even tho of the same age.

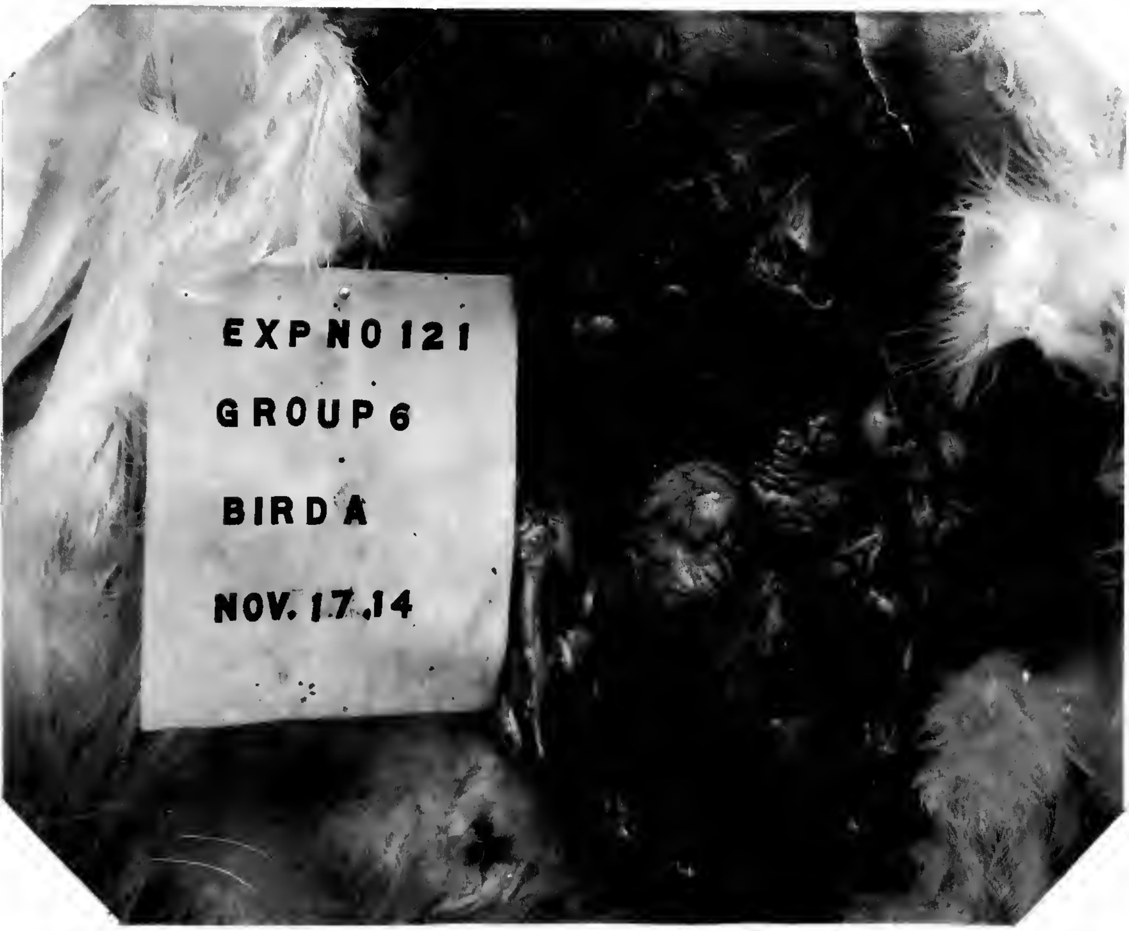
(Note) Plate of bird C was destroyed. The stage of developmement can be seen from picture on page 33.

Reproductive system of pullet hen, having laid but a single egg.

Bird A-5 months and 3 weeks old.

Bird B-7 months and 2 weeks old.

Bird C-7 months and 2 weeks old.

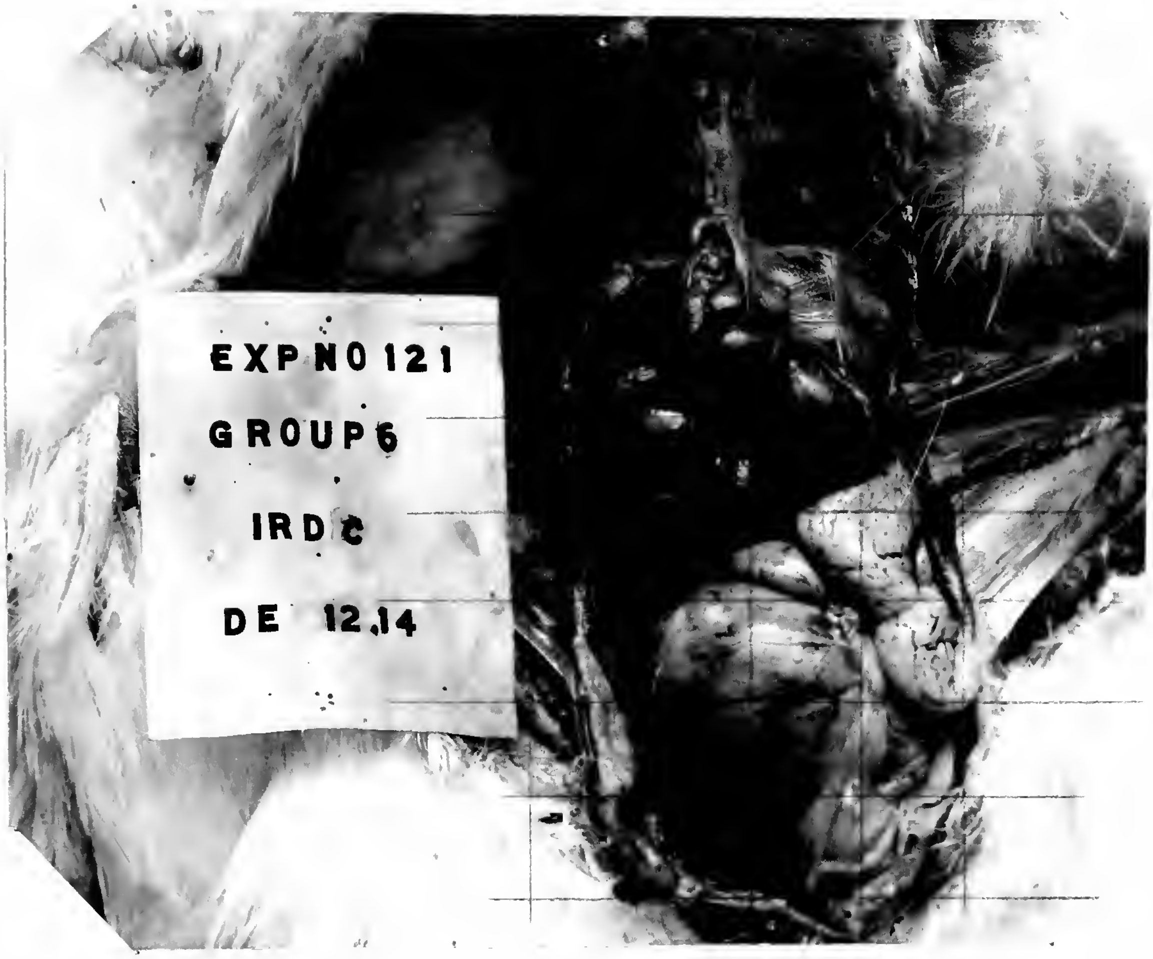


Group VI. Bird A. Age 5 mos 3 wks.

Reproductive system of pullet hen, having laid but a single egg, lying in the natural position in the body cavity.

Group VI Bird B-Age 7 mos 2 Wks .

Reproductive system of the pullet hen, having laid but a single egg. lying in natural position in the body cavity,



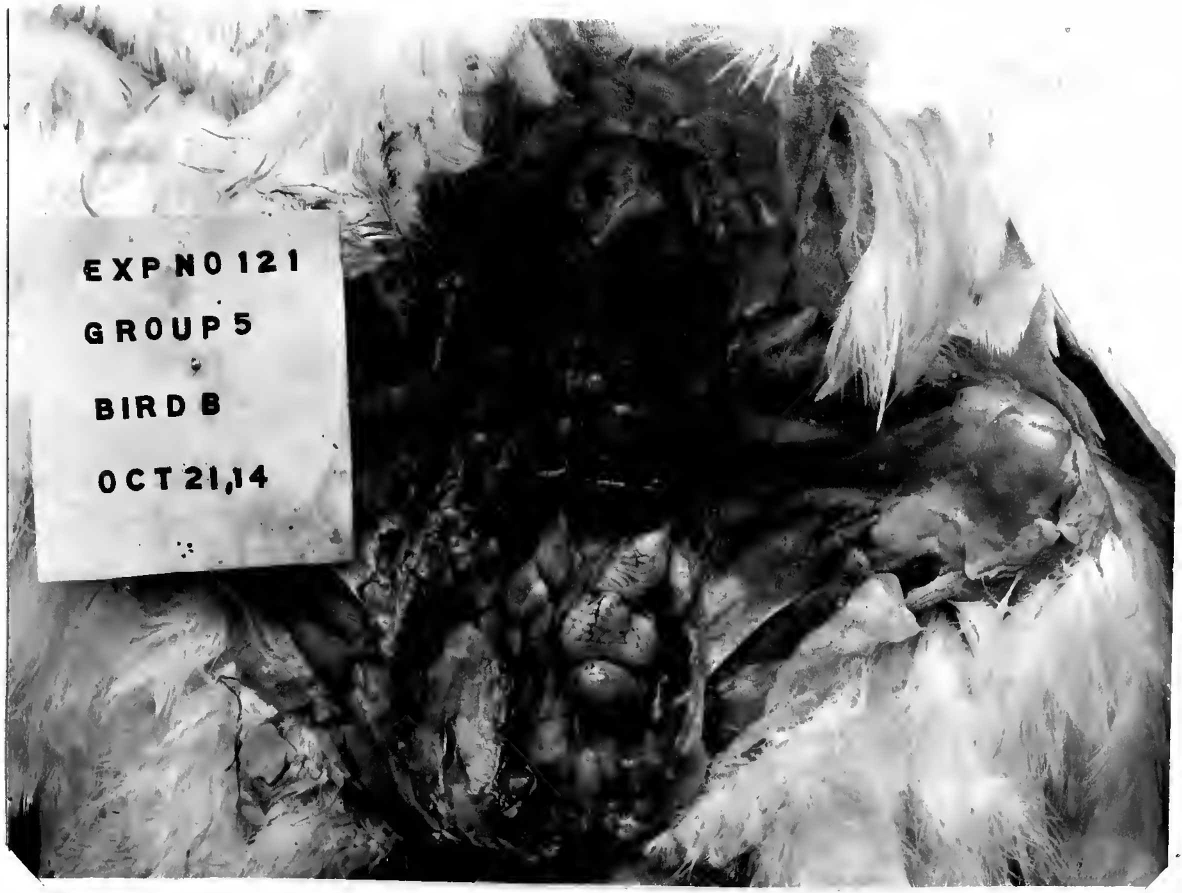
Group VI Bird C Age 7 mos and 2 wks.

Reproductive system of the pullet hen having laid but a single egg, and lying in the natural position in the body cavity.

Reproductive system of pullet hen, having laid for a period of two or three weeks. Age 5 months and three weeks old.

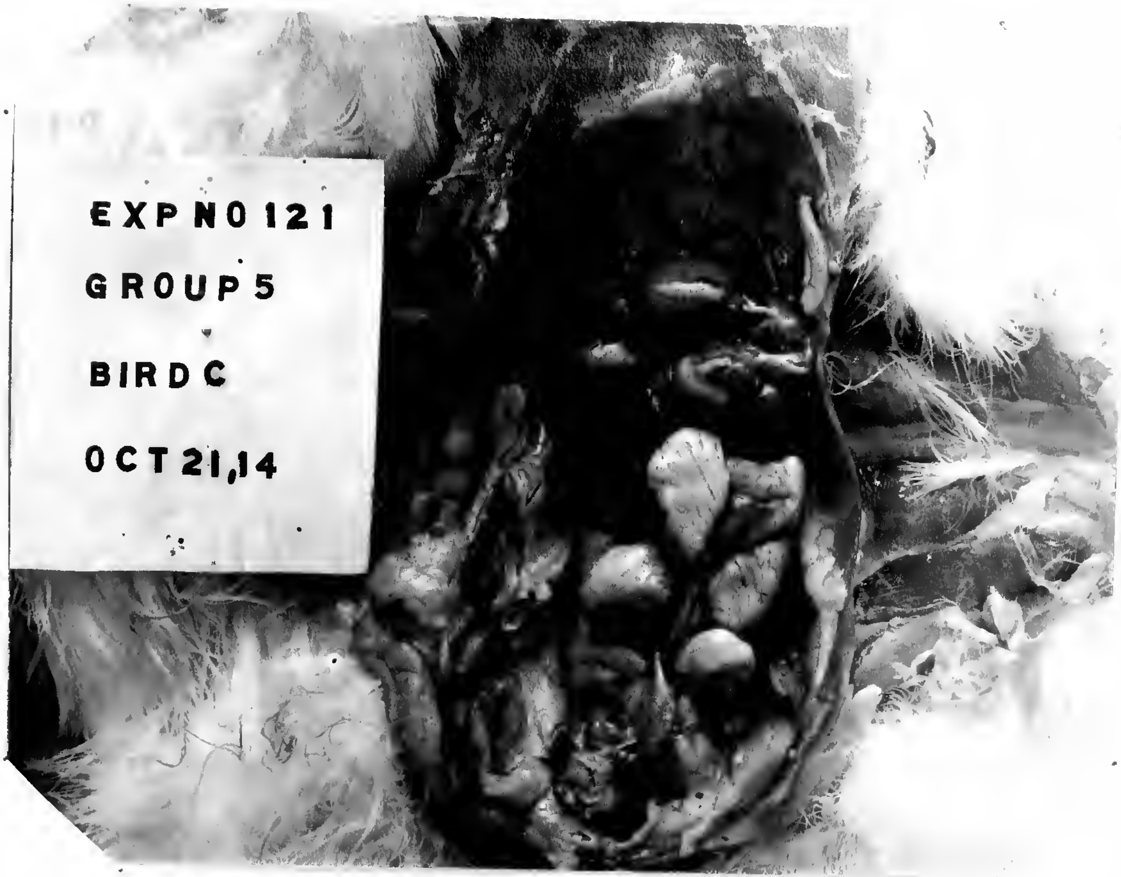
Group V Bird A   Age 5 mos and three wks.

Reproductive system of pullet hen, lying in the natural position in the body cavity. Bird having laid for a period of two or three weeks .



Group V Bird B. Age 5 mos-3 weeks.

Reproductive system of the pullet hen, lying in the natural position in the body cavity, Bird -nhaving laid for a period of two or three weeks.

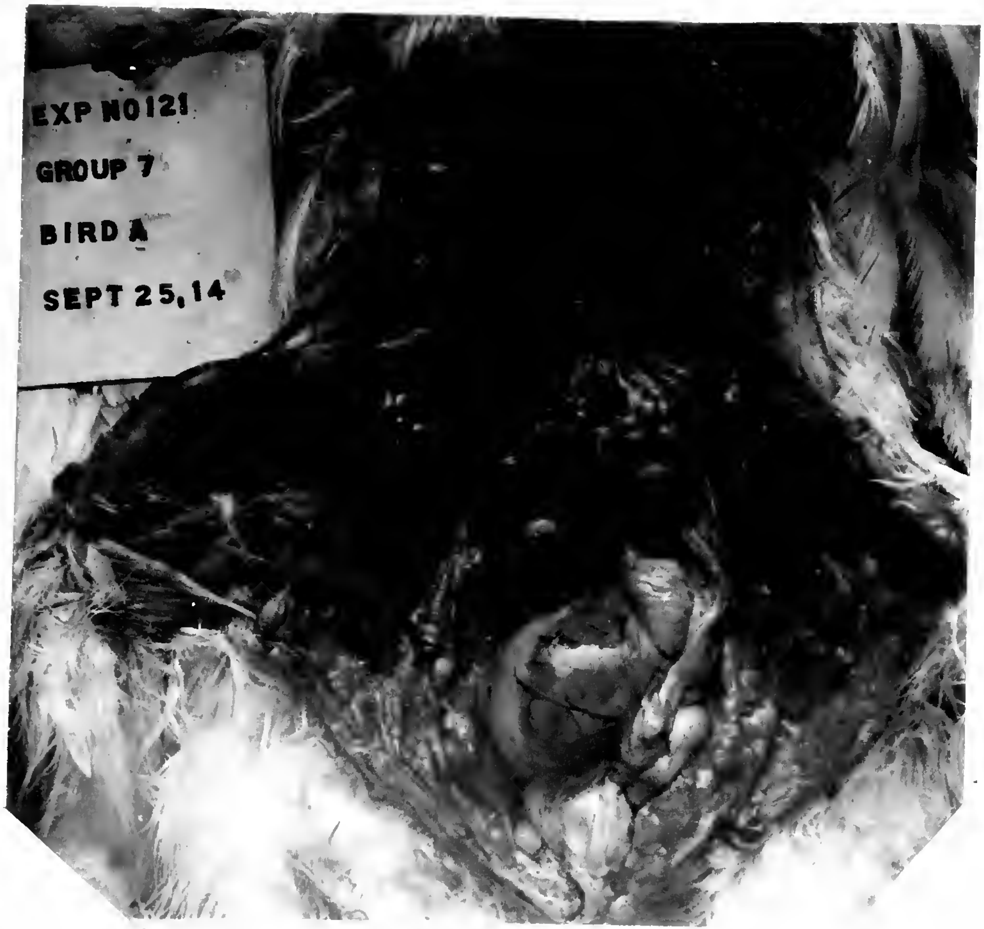


Group V bird C. Age 5 mos -3 wks.

Reproductive system of the pullet hen,lying in the natural position in the body cavity.Bird having laid for a period of two or three weeks.

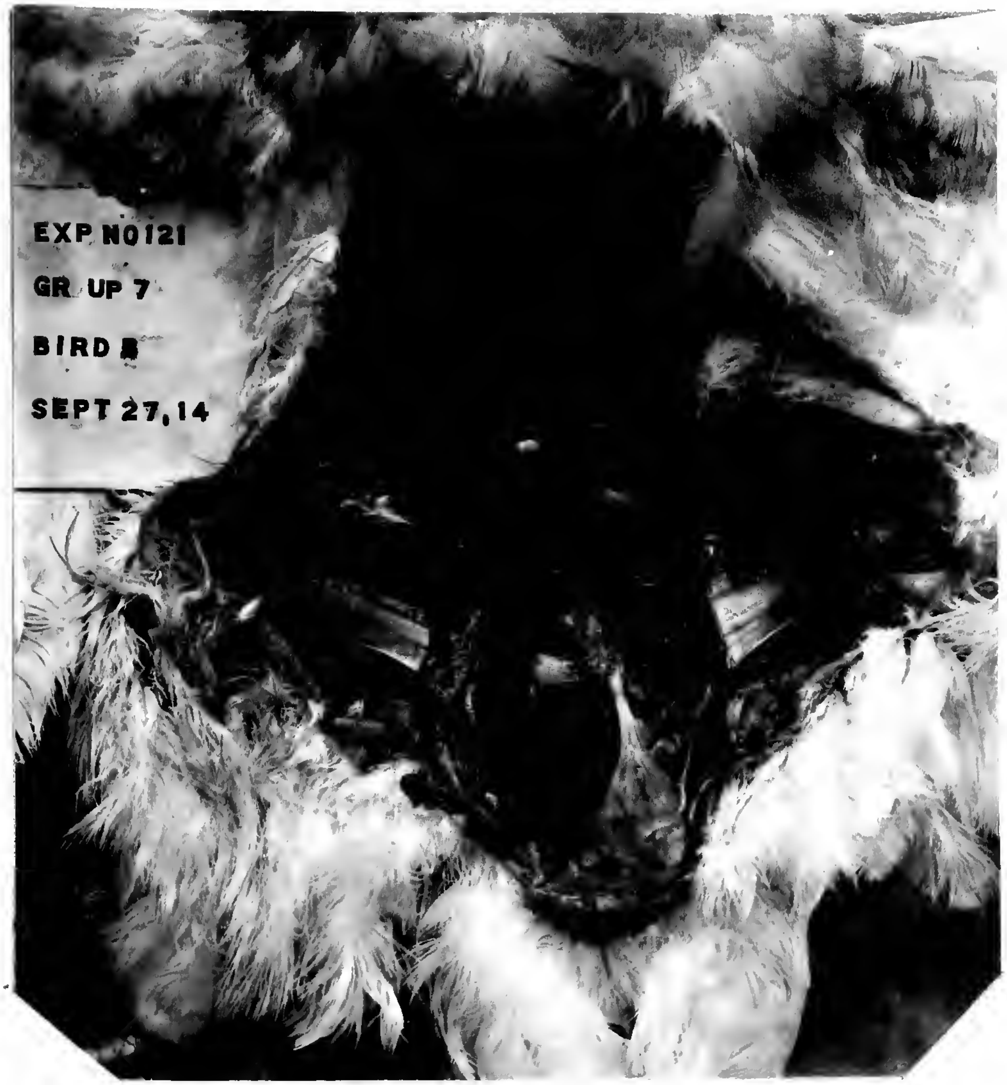
Group 7.

Reproductive system of pullet hen, about 18 months of age and just prior to the close of the laying season.



Group VII Bird A, About 18 Mos old.

Reproductive system of pullet hen, lying in natural position in the body cavity. Bird in a full state of production but just prior to the close of the laying season.

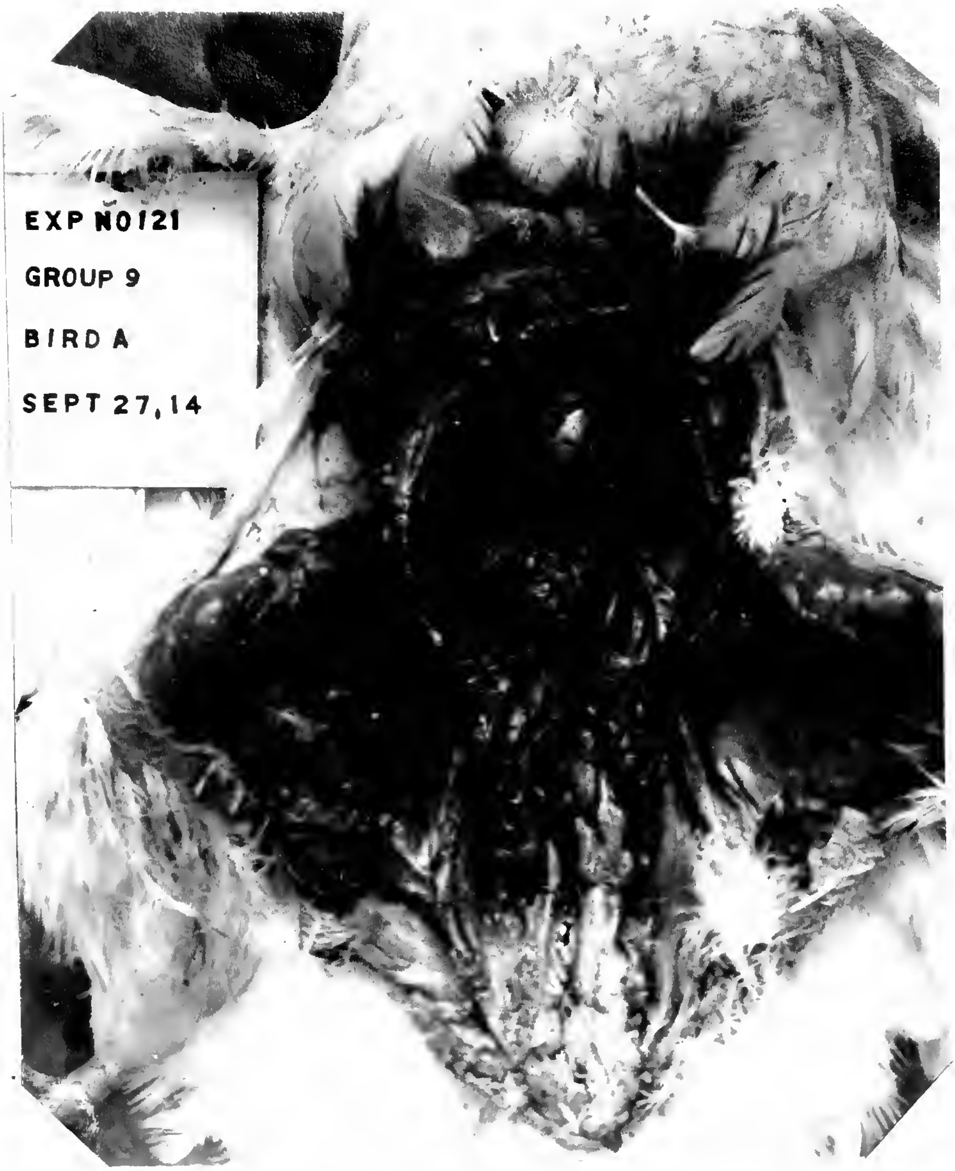


Group VII-Bird B-About 18 months of age.

Reproductive system of the pullet hen, lying in the natural position in the body cavity. Bird in a full state of production but just prior to the close of the laying season.

Reproductive system of hen about 18 months of age and in a complete of broodiness.

Reproductive system of hen about I8 mos old at close of the laying season.

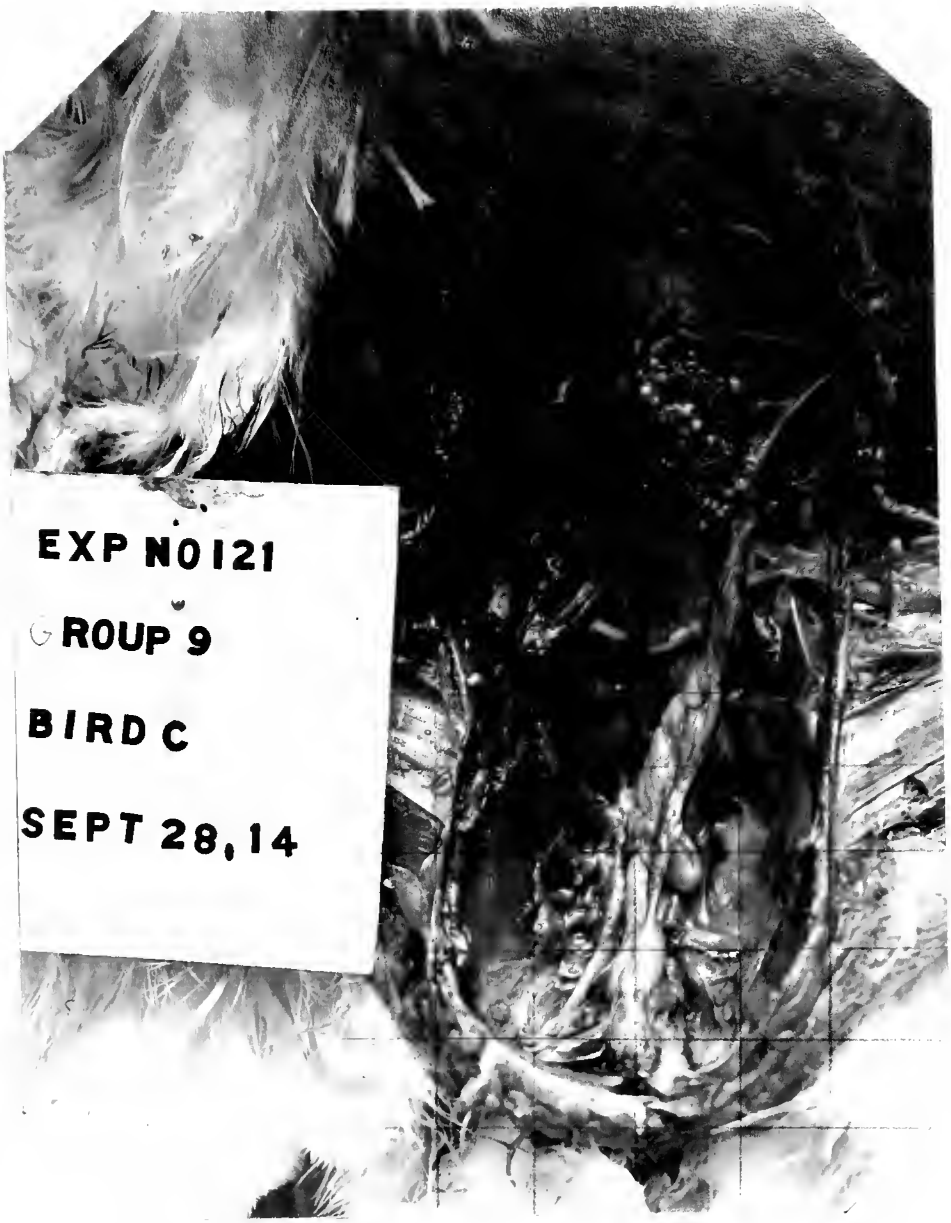


Group IX.Bird A- About 18 mos of age.

Reproductive system of hen about 18 mos of age and lying in natural position in the body ccavity.The bird has closed its first laying season.

Group IX Bird B About 18 mos of age.

Reproductive system of hen about 18 mos of age and lying in natural position in the body cavity. The bird has closed its first laying season.



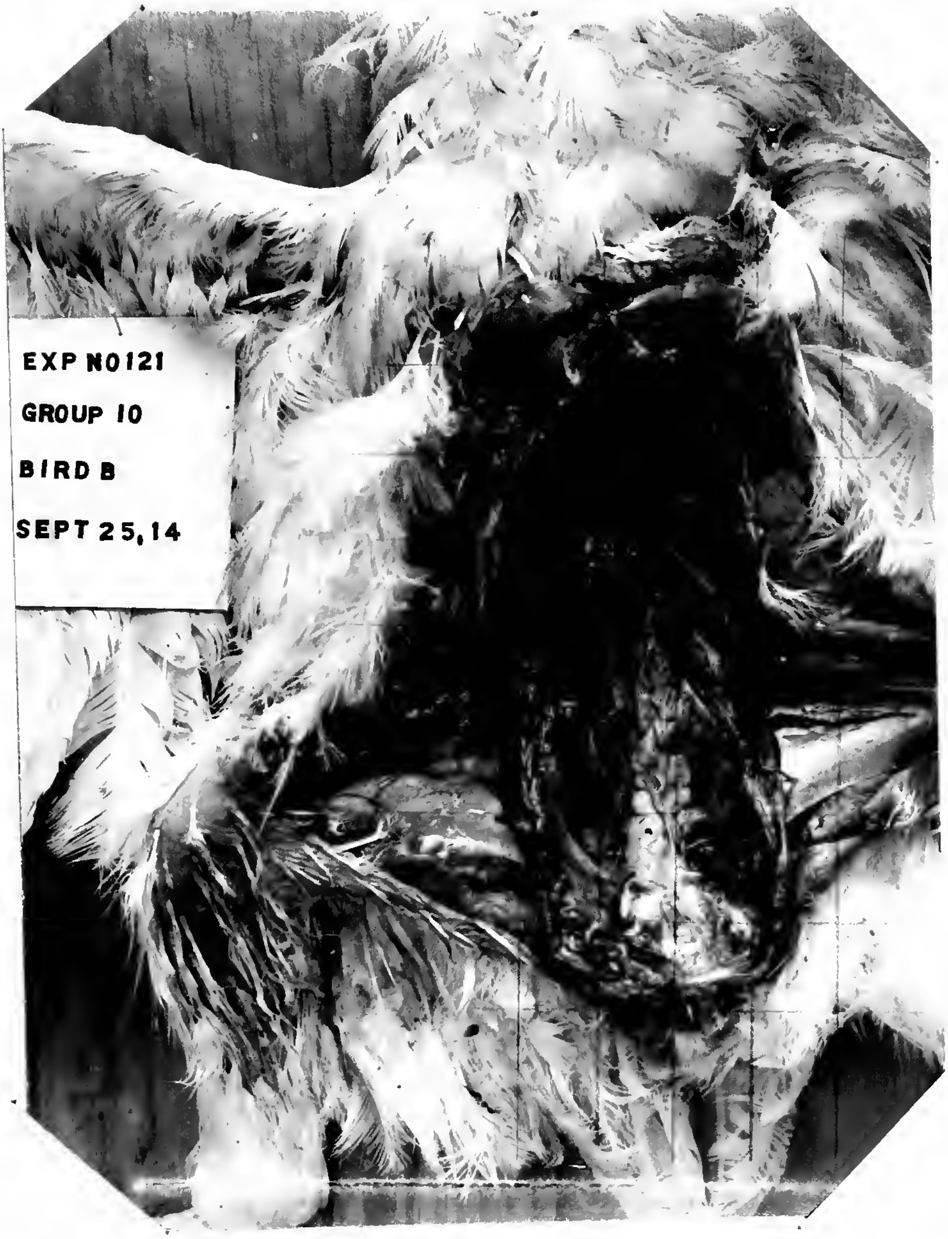
Group IX.Bird about 18 mos of age.

Reproductive system of hen about 18 mos of age and lying in natural position in the body cavity. The bird has closed its first laying season.

Reproductive system of hen in a state of molting. About 16-18 mos of age.

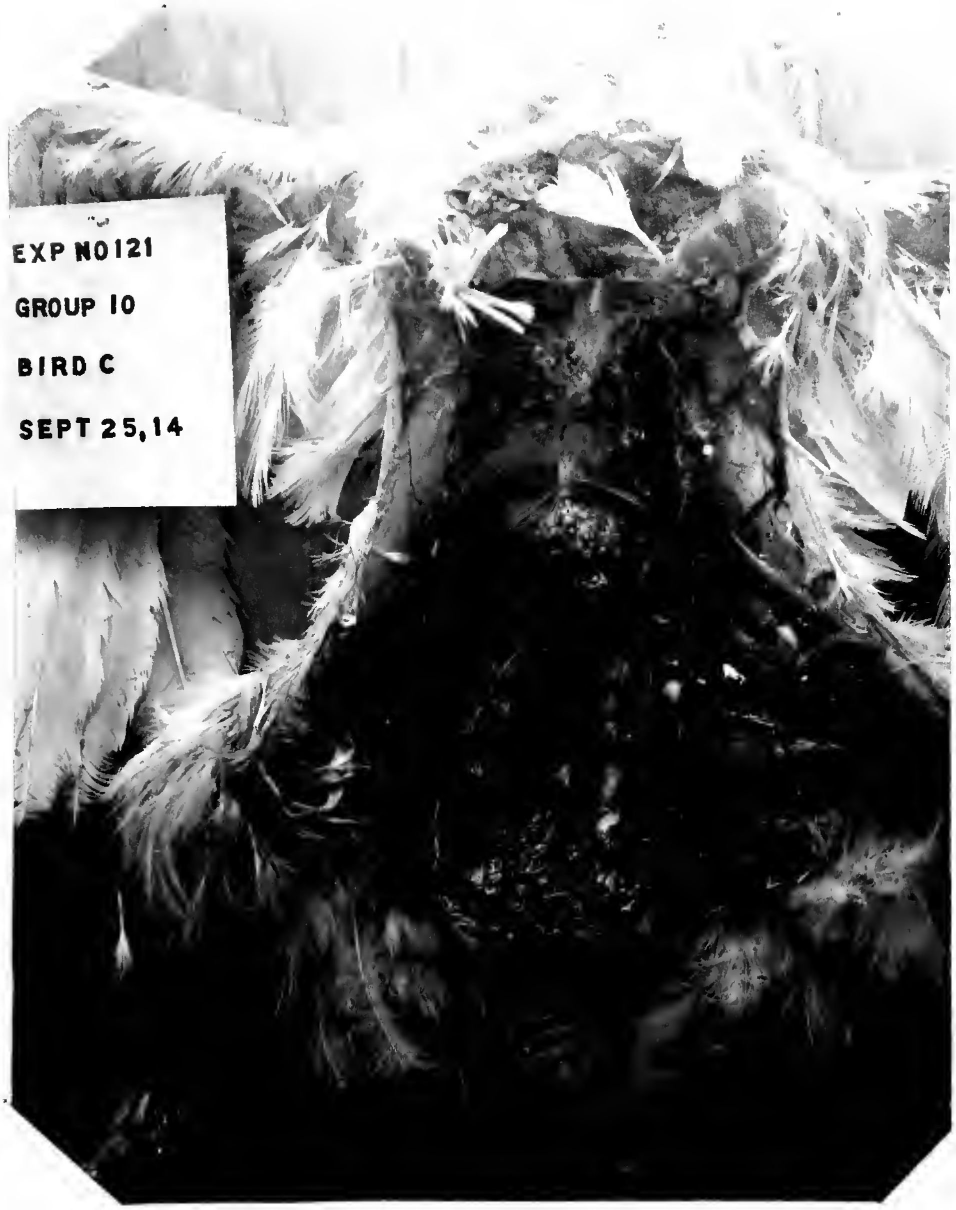
Group X Bird A - About 18 mos of age.

Reproductive system of hen in a state of molt. with organs lying in a natural position in the body cavity.



GroupX Bird B-About 18 mos of age.

Reproductive system of hen in a state of molt, with organs lying in a natural position in the body cavity.



Group X Bird C About 18 mos of age.

Reproductive system of hen in a state of molt, with organs lying in a natural position in the body cavity.

Reproductive systemmof hen after having molted and again statted to lay

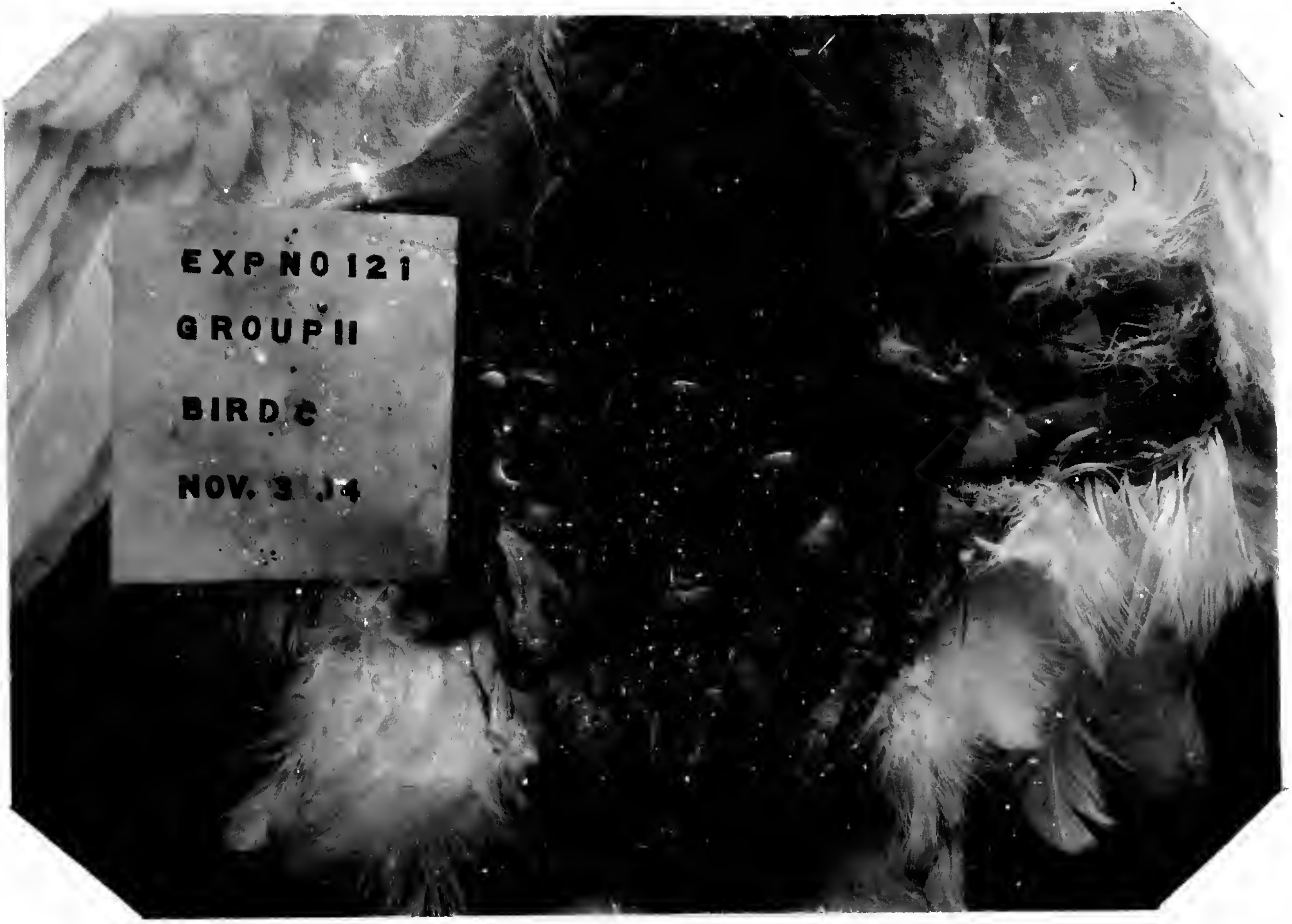
Age about 18 - 20 months.

Group XI*Bird A-About 18- 20 months of age,

Reproductive system of hen in natural position in the body cavity.The bird has gone thru its annual molt and again stated to lay.

Group XI-Bird B-About 18- 20 months old.

Reproductive system of hen in natural position in the body cavity. The bird has gone thru its annual molt and again started to lay.



Group XI Bird C About 18-20 months of age.

Reproductive system of hen ,in the natural position in the body cavity.The bird has gone thru its annual molt and again started to lay.